

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY DOCKET NO.

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 USC 371**

440490/PALL

U.S. APPLICATION NO.

097890355INTERNATIONAL APPLICATION NO.
PCT/US00/02701INTERNATIONAL FILING DATE
January 31, 2000PRIORITY DATE CLAIMED
January 29, 1999

TITLE OF INVENTION

SEPARATION DEVICES AND PROCESSES


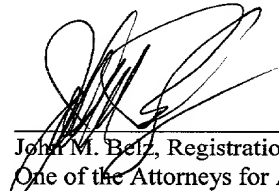
APPLICANT(S) FOR DO/EO/US
PALL CORPORATION

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 USC 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.
3. ☒ This is an express request to begin national examination procedures (35 USC 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 USC 371(c)(2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 USC 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 USC 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).
11. Nucleotide and/or Amino Acid Sequence Submission
 - a. ☐ Computer Readable Form (CRF)
 - b. Specification Sequence Listing on:
 - i. ☐ CD-ROM or CD-R (2 copies); or
 - ii. ☐ Paper Copy
 - c. ☐ Statement verifying identity of above copies

Items 12 to 19 below concern other document(s) or information included:

12. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
 - ☐ Form PTO-1449
 - ☐ Copies of Listed Documents
13. ☐ An assignment for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14. ☐ A FIRST preliminary amendment.
 - ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☒ Application Data Sheet Under 37 CFR 1.76
18. ☒ Return Receipt Postcard
19. ☒ Other items or information: Copy of application as filed and corrected drawings; International Search Report (Forms PCT/ISA/220 and PCT/ISA/210); and International Preliminary Examination Report (Forms PCT/IPEA/416 and PCT/IPEA/409)

U.S. APPLICATION NO. 09/890355		INTERNATIONAL APPLICATION NO. PCT/US00/02701		ATTORNEY DOCKET NO. 440490/PALL	
20. <input checked="" type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1,000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$ 860.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO, but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$ 710.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$ 690.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1) to (4) \$ 100.00				CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT=				\$690.00	
Surcharge of \$130.00 for furnishing the National fee or oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date				\$	
CLAIMS		NUMBER FILED	NUMBER EXTRA	RATE	
Total Claims	7	-20=		x \$ 18.00	\$
Independent Claims	7	- 3 =	4	x \$ 80.00	\$320.00
<input type="checkbox"/> Multiple Dependent Claim(s) (if applicable)				+\$270.00	\$
TOTAL OF ABOVE CALCULATIONS=				\$1010.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$	
SUBTOTAL=				\$	
Processing fee of \$130.00 for furnishing English Translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date.				\$	
TOTAL NATIONAL FEE=				\$1010.00	
Fee for recording the enclosed assignment. The assignment must be accompanied by an appropriate cover sheet. \$40.00 per property				+	\$
TOTAL FEE ENCLOSED=				\$1010.00	
				Amount to be:	
				refunded	\$
				charged:	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$1010.00 to cover the above fee is enclosed. b. <input type="checkbox"/> Please charge Deposit Account No. 12-1216 in the amount of \$ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 12-1216. A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO:					
		 John M. Belz, Registration No. 30,359 One of the Attorneys for Applicant(s)			
		30 July 2001 Date			

In re Appln. of FENDYA, ET AL.
Attorney Docket No. 440490

Full name of third joint inventor: John D. Miller

Inventor's signature

Date

3/8/02

Country of Citizenship: USA

Residence: Ithaca, New York

Post Office Address: 511 Kline Road, Ithaca, NY 14850

39-45 48th St.
Sunnyside, NY 11109
NY

Full name of fourth joint inventor: Stephen A. Geibel

Inventor's signature

Date

Country of Citizenship: USA

Residence: Cortland, New York

Post Office Address: 31 Prospect Terrace, Cortland, NY 13045

003749 000000000000

In re Appln. of FENDYA, ET AL.
Attorney Docket No. 440490

Full name of third joint inventor: John D. Miller

Inventor's signature _____

Date _____

Country of Citizenship: USA

Residence: Ithaca, New York

Post Office Address: 511 Kline Road, Ithaca, NY 14850

Full name of fourth joint inventor: Stephen A. Geibel

Inventor's signature _____

Date March 11, 2002

Country of Citizenship: USA

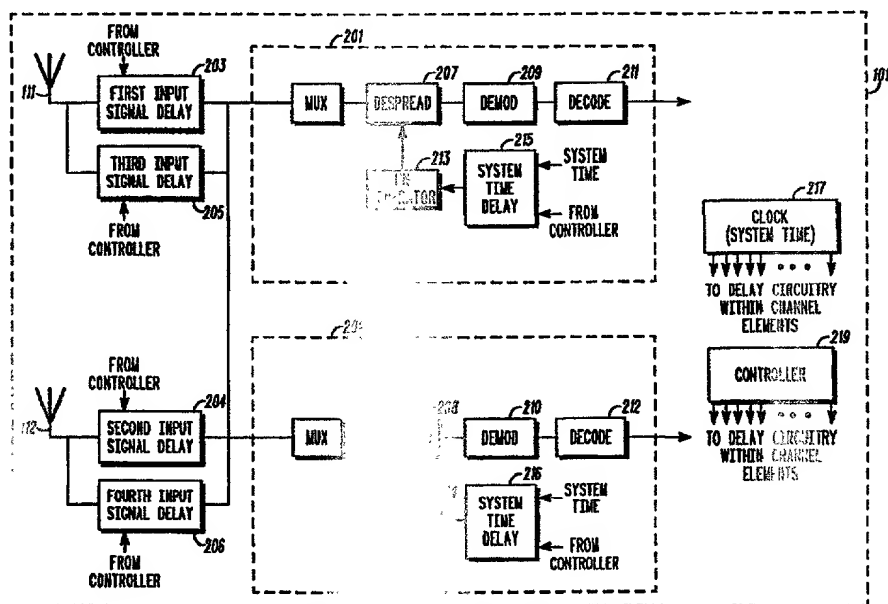
Residence: Cortland, New York

Post Office Address: 31 Prospect Terrace, Cortland, NY 13045



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : H04B 7/216, 15/00, H04J 13/02, 13/00, H03D 1/04	A1	(11) International Publication Number: WO 00/52850 (43) International Publication Date: 8 September 2000 (08.09.00)
(21) International Application Number: PCT/US00/02701 (22) International Filing Date: 2 February 2000 (02.02.00) (30) Priority Data: 09/260,697 2 March 1999 (02.03.99) US (71) Applicant: MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US). (72) Inventors: CORDELL, Donald, Paul; 2214 Aspen Drive, Woodstock, IL 60098 (US). SCHAFFNER, Terry, Michael; 268 Eisenhower Court, Palatine, IL 60067 (US). (74) Agents: HAAS, Kenneth, A. et al.; Motorola Inc., Intellectual Property Dept., 1303 East Algonquin Road, Schaumburg, IL 60196 (US).		(81) Designated States: BR, JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: RANGE EXTENSION WITHIN A COMMUNICATION SYSTEM**(57) Abstract**

Receiver (101) within a base station (101) receives a signal (111) and delays it by a first amount by delay circuitry (203), and a second amount by delay circuitry (205). The signal is then despread with a pseudo-random (PN) code. The system also includes delay circuitry (215, 216).

transmission from a remote unit (114). The received signal is delayed a second amount by delay circuitry (204). During demodulation, a delayed input signal is received by the PN generators (213, 214) and delayed a third time period by

RANGE EXTENSION WITHIN A COMMUNICATION SYSTEM

Field of the Invention

5

The present invention relates generally to communication systems and, in particular, to extending the range of a base site in a cellular communication system.

10

Background of the Invention

In current Code Division, Multiple Access (CDMA) communication systems, receivers (channel elements) restrict a search and demodulation window to 512 chips. More particularly, a remote unit accessing a CDMA communication system can have a round-trip delay of no more than 416 micro seconds (512 chips), or equivalently, a maximum distance of 62 kilometers (km) from the base station. Remote units with a larger delay than 512 chips will not be within a base station's search window, and will not be acquired by the base station.

Although the above restriction on round-trip delay is adequate for most urban areas, there exists locations where a maximum cell size of greater than 62 km is desired. For example, along coastal areas, or within very sparsely populated locations, it may be economically unfeasible to have small cell sizes. Therefore a need exists for a base station that has an extended cell size. Additionally, it would be beneficial if existing CDMA equipment can be inexpensively modified to provide such coverage.

Brief Description of Drawings

30

FIG. 1 is a block diagram of a communication system in accordance with the preferred embodiment of the present invention.

FIG. 2 is a block diagram of the base station of FIG. 1 in accordance with the preferred embodiment of the present invention.

- 2 -

FIG. 3 is a flow chart showing operation of the base station of FIG. 1 in accordance with the preferred embodiment of the present invention.

5 Detailed Description of the Drawings

To address the need for a base station having an extended cell size, a method and apparatus for extending the cell size of a base station is provided. Receivers within a base station receive a transmission from a remote unit. The received signal is delayed a first amount by first delay circuitry, and a second amount by second delay circuitry. During despreading, a delayed input signal is despread with a Pseudo-Random (PN) code. The system time utilized by the PN generators is delayed a third time period by third and fourth delaying circuitry. As a result of delaying system time, the PN sequence utilized to despread the delayed signals will not repeat on the even second of system time, but will begin repeating a time period after every even second of system time. By delaying the signal input into a receiver, as well as delaying system time utilized by the PN generator, allows base stations to receiving transmissions from remote units outside the normal 512 chip window. Additionally, existing base stations can be inexpensively modified in accordance with the preferred embodiment by the addition of delay circuitry as described above.

The present invention encompasses an apparatus for range extension within a communication system. The apparatus comprises a first receiver comprising a first input signal delay circuitry receiving a received signal as an input and outputting the received signal delayed a first time period. The receiver additionally comprises a first despread circuitry receiving the received signal delayed the first time period as an input and outputting a first despread signal, wherein the first despread circuitry utilizes a spreading code that is delayed a second time period with respect to system time.

The present invention additionally encompasses a method for range extension within a communication system. The method comprises the steps of receiving a first signal and delaying the first signal a first time period to produce a first delayed signal. The delayed signal is then despread utilizing a spreading code that is delayed a second time period with respect to system time in order to receive signals transmitted

within a first range. The method additionally comprises the steps of receiving a second signal and delaying the second signal a third time period to produce a second delayed signal. The second delayed signal is despread utilizing the spreading code that has been delayed the second time period in order to receive
 5 signals transmitted within a second range.

The present invention additionally encompasses a method for range extension within a Code Division, Multiple Access (CDMA) communication system. The method comprises the steps of receiving a first signal transmitted from a remote unit and delaying the first signal a first time period to produce a
 10 first delayed signal. In this embodiment of the invention the first time period is equal to a time period selected from the group consisting of 0, N, 2N, . . . , (K-1)N, where N is a maximum search and demodulation range of the second receiver and K is the maximum round-trip delay divided by N, rounded up to a nearest integer. The first delayed signal is despread utilizing a Pseudo-Random (PN) code
 15 that has been delayed a second time period in order to receive signals transmitted within a first range. The method also comprises the steps of receiving a second signal transmitted from the remote unit and delaying the second signal a third time period to produce a second delayed signal. In this embodiment of the present invention the third time period is equal to a time period selected from the group
 20 consisting of 0, N, 2N, . . . , (K-1)N. Finally, the second delayed signal is despread utilizing the PN code that has been delayed the second time period in order to receive signals transmitted within a second range.

Turning now to the drawings, where like numerals designate like components, FIG. 1 is a block diagram of communication system 100 in
 2 accordance with the preferred embodiment of the present invention. In the preferred embodiment of the present invention, communication system 100 utilizes a CDMA system protocol as described in Cellular System Remote unit-Base Station Compatibility Standard of the Electronic Industry Association/Telecommunications Industry Association Interim Standard 95-B (EIA/EIA/IS-95B), which is incorporated by reference herein. (TIA/TIA can be contacted at 2001 Pennsylvania Ave. NW Washington DC 20006). In alternate
 embodiments communication system 100 may utilize other analog or digital cellular communication system protocols such as, but not limited to, the Narrowband Advanced Mobile Phone Service (NAMPS) protocol, the Advanced Mobile

- 4 -

Phone Service (AMPS) protocol, the Global System for Mobile Communications (GSM) protocol, the Personal Digital Cellular (PDC) protocol, or the United States Digital Cellular (USDC) protocol. Communication system 100 includes sectorized cell 115, and base station 101 which is suitably coupled to antennas 108-113. Although not shown, one of ordinary skill in the art will recognize that base station 101 is additionally coupled to necessary infrastructure equipment such as Centralized Base Station Controllers (CBSCs), Mobile Switching Centers (MSCs), and the like.

In the preferred embodiment of the present invention maximum cell range is increased by increasing the range for specified sectors 102-107 only. Thus, in the preferred embodiment of the present invention each sector 102-107 of cell site 115 has a maximum and minimum operational range. A first sector (e.g., sector 104) may receive remote units within a first region (e.g., 0-62 km from base station 101), while an adjacent sector (e.g., sector 105) will receive only remote units within a second region (between 62 km and 124 km from base station 101). Additionally, as will be described below, the maximum cell radius of cell 115 is increased without requiring a redesign of the existing infrastructure equipment's receivers.

FIG. 2 is a block diagram of base station 101 in accordance with the preferred embodiment of the present invention. As shown base station 101 comprises first receiver 201 and second receiver 202. Although only two receivers are shown, one of ordinary skill in the art will recognize that typical base stations comprise many receivers. For example, the Motorola J-CDMA Base Station (SC4840) contains twelve channel cards with 24 receivers residing on each card, resulting in a total of 288 receivers. FIG. 2 additionally shows receivers 201 and 202 having a single antenna port with antennas 111 and 112 as inputs, however, one of ordinary skill in the art will recognize that multiple antennas may be input into receivers 201 and 202 in order to gain diversity benefits. In the preferred embodiment of the present invention receiver 201 and receiver 202 have input antennas (111 and 112, respectively) originating from different sectors (104 and 105, respectively).

As shown, base station 101 comprises input signal processing circuitry 203-206, and each receiver comprises system time delay circuitry 207, 208, despreading circuitry 209, 210, decoding circuitry 211, 212,

and PN generators 213, 214. Base station 101 additionally comprises clock 217 to provide system time, and controller 219. In the preferred embodiment of the present invention delay circuitry 203-206 is a standard digital delay line, and delay circuitry 215-216 is a counter which produces a delayed version of the original system reference pulse. Both of these delay circuits serve to delay signals input into the circuitry for a finite period of time.

Prior to describing operation of base station 101, the following text and equations are provided to show derivation of the time delays utilized by delay circuitry 203-206 and 215-216.

Assume that N is the maximum search and demodulation range of a receiver, and K is the number of search windows that are necessary for covering the desired range. K is equal to the maximum round-trip delay divided by N , rounded up to the nearest integer (i.e., $K = \text{Round_up}(\text{maxRTD}/N)$). For example, if a maximum search and demodulation range of a receiver is 512 chips (62 km), and it is desired that base station 101 be able to receive calls having delays of 826 chips (100 km), then $N=512$ and $K=2$ ($\text{Round_up}(826/512)$). In the preferred embodiment of the present invention system time delay circuitry 215 and 216 delay system reference time by a time period equal to $(K-1)N$.

In the preferred embodiment of the present invention signals input into receivers 201-202 are delayed for a period of time prior to being despread. The period of time that a particular signal is delayed is dependent upon a particular range that the receiver wishes to cover. In the preferred embodiment of the present invention these delays are integer multiples of N , up to $(K-1)N$ (i.e., $0, N, 2N, \dots, (K-1)N$). Using the above example, with $N=512$ and $K=2$, there exist two distinct input signal delays utilized by base station 101 (0 and 512 chips). Therefore, when $K=2$, system time is delayed by 512 chips for receivers having no delay perceive a signal transmitted with an 826 chip offset as being transmitted with a 326 chip offset. In other words, actual PN offsets of $(K-1)N$ to KN appear to be offset only 0 to N to the non-delayed baseband.

It should be noted that receivers having a range of jN receive remote units having PN offsets of $(NK-N-jN)$ to $(NK-N)$. Therefore, any remote unit with a range of $(NK-N-jN)$ and $(NK-N)$ is received by the receiver delayed by jN and not be received by receivers having different input signal

delays since the signal will lie outside of the receiver's search window. This is illustrated in Table 1 for N=512, K=3, and system time delayed 1024 chips.

Input signal delay	Perceived offset for remote unit transmitting between 0-62 km (0-511 chip offset)	Perceived offset for remote unit transmitting between 63-124 km (512-1023 chip offset)	Perceived offset for remote unit transmitting between 125-186 km (1024-1535 chip offset)
0 chips	-1024 to -513 chips	-512 to -1 chips	0 to 511 chips
512 chips	-512 to -1 chips	0 to 511 chips	512 to 1023 chips
1024 chips	0 to 511 chips	512 to 1023 chips	1024 to 1535 chips

Table 1.

5 Illustration of perceived chip offsets at varying distances from a base station.

As illustrated in Table 1, when system time is delayed 1024 chips, receivers having input signal delays of zero chips will perceive remote units between 125 and 186 km as having chip offsets of between 0 and 511. Likewise, 10 receivers having input signal delays of 512 chips, will perceive remote units between 63 and 124 km as having chip offsets between 0 and 511. Finally, receivers having input signal delays of 1024 chips will perceive remote units between 0 and 62 km as having chip offsets between 0 and 511. All receivers will be unable to receive remote units whose transmissions are perceived to be outside 15 the 0 to 511 chip window.

The above-described base station is capable of receiving transmissions from remote units outside the normal 512 chip window. In fact, the above-described base station can receive transmissions from remote units that are delayed up to 1535 chips. Additionally, existing base stations can be inexpensively 20 modified in accordance with the preferred embodiment by the addition of delay circuitry as described above.

FIG. 1 is a flow chart showing operation of the base station of FIG. 1 in accordance with the preferred embodiment of the present invention. The logic flow begins at block 300 where receivers 201-202 determine an antenna and delay 25 window for each receiver to demodulate (e.g., antenna 111 with first delay 203, and antenna 112 with second delay 204). In particular, in the preferred embodiment

- 7 -

the present invention each receiver may choose to demodulate signals from any antenna coupled to base station 101. Additionally, each antenna has multiple signal delays that may be chosen by receivers 201-202, depending upon an amount of range extension desired for base station 101. In the preferred embodiment of the present invention multiplexers within each receiver 201-202 choose an antenna and a particular delay from all possibilities of antenna/delay combinations. For purposes of this example it is assumed that receiver 201 chooses antenna 111, having delay 203 as an input, and receiver 202 chooses antenna 112, having delay 204 as an input.

Continuing, at step 301 receivers 201 and 202 receive a transmission from remote unit 114. At step 303 the received signal is delayed a first amount by circuitry 203, and a second amount by circuitry 204. As discussed above, these delays are integer multiples of N , up to $(K-1)N$ (i.e., $0, N, 2N, \dots, (K-1)N$). Additionally, delay circuitry 203 and 204 may exist after demodulating the received signal into its baseband components, or may simply serve to delay the received radio-frequency (RF) signal prior to demodulation.

At step 305 the delayed signals are output from delay circuitry 203 and 204, and enter despreaders 207 and 208 respectively. At step 307 despreaders 207 and 208 utilize standard CDMA despreading techniques to despread the delayed signals. More particularly, during despreading, the delayed input signal is despread with a Pseudo-Random (PN) code. The PN code is a 32,768 bit sequence that repeats exactly 75 times every 2 seconds with a chip rate of 1.2288 MegaChips per second. In standard CDMA systems the PN sequence is synchronized to repeat on every even second of system time. Although in the preferred embodiment of the present invention the spreading code utilized is a PN code, one of ordinary skill in the art will recognize that other spreading codes may be utilized as well. At step 307 the system time utilized by PN generators 213 and 214 is delayed a third time period equal to $(K-1)N$ chips by circuitry 215 and 216, respectively. As a result of delaying system time, the PN sequences used to despread the delayed signals will not repeat on the even second of system time, but will begin repeating $(K-1)N$ chips after every even second of system time.

Finally, at step 309 the despread data is demodulated by demodulators 209 and 210, and decoded by decoder 211. In the preferred embodiment of the present invention

invention despreading and demodulation operations are standard CDMA demodulating/decoding operations described in detail in IS-95B.

As described above, receivers having input signal delays of jN receive remote units having PN offset ranges of $(NK-N-jN)$ to $(NK-jN)$ when system time is delayed by $(K-1)N$. Therefore, any remote unit with a range between $(NK-N-jN)$ and $(NK-jN)$ will be received by the receiver delayed by jN , and will not be received by receivers having different input signal delays since the signal will lie outside of the receiver's search window. The result is a base station capable of receiving transmissions from remote units outside the normal operating window.

Additionally, the above-described base station can receive transmissions from remote units that are delayed up to KN chips with receivers having input signal delays of jN . Additionally, existing base stations can be inexpensively modified in accordance with the preferred embodiment by the addition of delay circuitry as shown.

Also note that in the preferred embodiment each receiver is a RAKE receiver having multiple despreaders. A multiplexer is provided for each despreaders to select an antenna and delay. The output of the despreaders are separately demodulated, combined together, then decoded. Each receiver, therefore, has the ability to demodulate received signals spread across multiple windows.

The descriptions of the invention, the specific details and the drawings mentioned above, are not meant to limit the scope of the present invention. For example, in alternate embodiments of the present invention the radius can be expanded or contracted by adjusting the delay times for circuitry 203, 204, 215, and 216 accordingly. It is envisioned in such an embodiment that controller 219 utilizes clock 217 (system time) and dynamically adjusts delay circuitry to utilize an appropriate delay. For example, during a first time period (e.g., day time hours) controller may delay system time by 1024 chips in order to extend the base station's range to 186 km, and during a second time period (e.g., night time hours) controller may delay system time by 512 chips in order to extend the base station's range to 124 km. It is the intent of the inventors that various modifications can be made to the present invention without varying from the scope of the invention, and it is intended that such modifications come within the scope of the following claims and equivalents.

Claims

1. An apparatus for range extension within a communication system, the apparatus comprising:
 - 5 a first receiver comprising:
 - a first input signal delay having a received signal as an input and outputting the received signal delayed a first time period; and
 - a first despreader having the received signal delayed the first time period as an input and outputting a first despread signal, wherein
 - 10 the first despreader utilizes a spreading code that is delayed a second time period with respect to system time.
 2. The apparatus of claim 1 further comprising:
 - a second receiver comprising:
 - 15 a second input signal delay having the received signal as an input and outputting the received signal delayed a third time period; and
 - a second despreader having the received signal delayed the third time period as an input and outputting a second despread signal, wherein the second despreader utilizes the spreading code that is
 - 20 delayed the second time period with respect to system time.
 3. The apparatus of claim 2 wherein the third time period is equal to a number selected from the set consisting of $0, N, 2N, \dots, (K-1)N$, where N is a maximum search and demodulation range of the second receiver and K is the maximum round-trip delay divided by N , rounded up to a nearest integer.
 - 25
 4. The apparatus of claim 2 wherein the second time period is substantially equal to $(K-1)N$, where N is a maximum search and demodulation range of the first receiver and K is a maximum round-trip delay divided by N , rounded up to a nearest integer.
 - 30
 5. The apparatus of claim 2 wherein the received signal input into the first input signal delay originates from a first sector of a base station and the received signal

- 10 -

input into the second input signal delay originates from a second sector of the base station.

6. A method for range extension within a communication system, the method comprising the steps of:

receiving a first signal;
 delaying the first signal a first time period to produce a first delayed signal;
 despreading the first delayed signal utilizing a spreading code that has been
 delayed a second time period in order to receive signals transmitted within a first
 range;
 receiving a second signal;
 delaying the second signal a third time period to produce a second delayed
 signal; and
 despreading the second delayed signal utilizing the spreading code that has
 been delayed the second time period in order to receive signals transmitted within
 a second range.

7. The method of claim 6 wherein the step of delaying the first signal the first time period comprises the step of delaying the first signal the first time period wherein the first time period is equal to a time period selected from the group consisting of 0, N, 2N, . . . , (K-1)N, where N is a maximum search and demodulation range of the second receiver and K is the maximum round-trip delay divided by N, rounded up to a nearest integer.

8. The method of claim 7 wherein the step of delaying the second signal the third time period comprises the step of delaying the second signal the third time period wherein the third time period is equal to a time period selected from the group consisting of 0, N, 2N, . . . , (K-1)N.

9. The method of claim 6 wherein the step of despreading the first delayed signal utilizing the spreading code that has been delayed the second time period comprises the step of despreading the first delayed signal utilizing the spreading code that has been delayed a time period substantially equal to (K-1)N, where N is

- 11 -

a maximum search and demodulation range of the first receiver and K is the maximum round-trip delay divided by N , rounded up to a nearest integer.

10. The method of claim 6 wherein the step of despreading the second delayed
5 signal utilizing the spreading code that has been delayed the second time period
comprises the step of despreading the second delayed signal utilizing the
spreading code that has been delayed a time period substantially equal to $(K-1)N$,
where N is a maximum search and demodulation range of the first receiver and K
is the maximum round-trip delay divided by N , rounded up to a nearest integer.

10

1/2

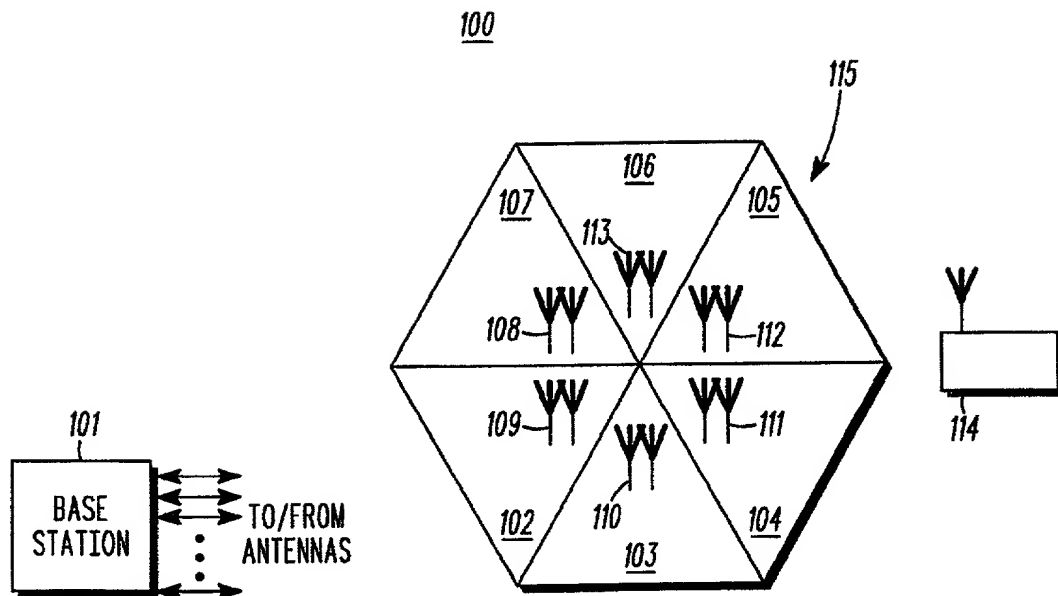


FIG. 1

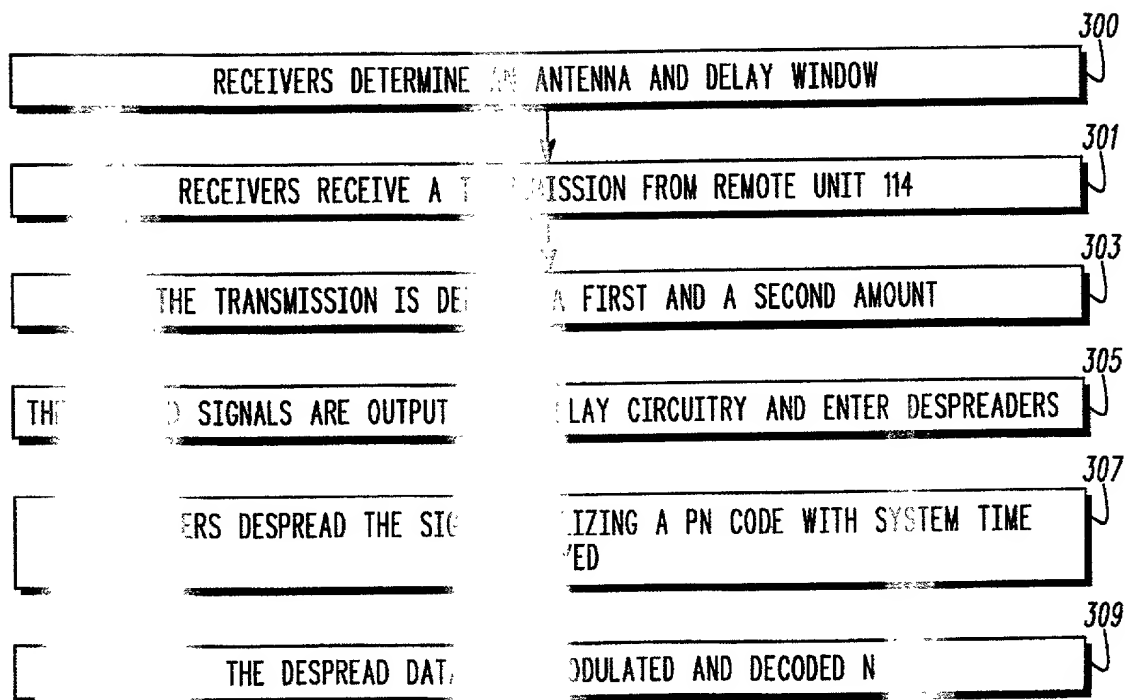
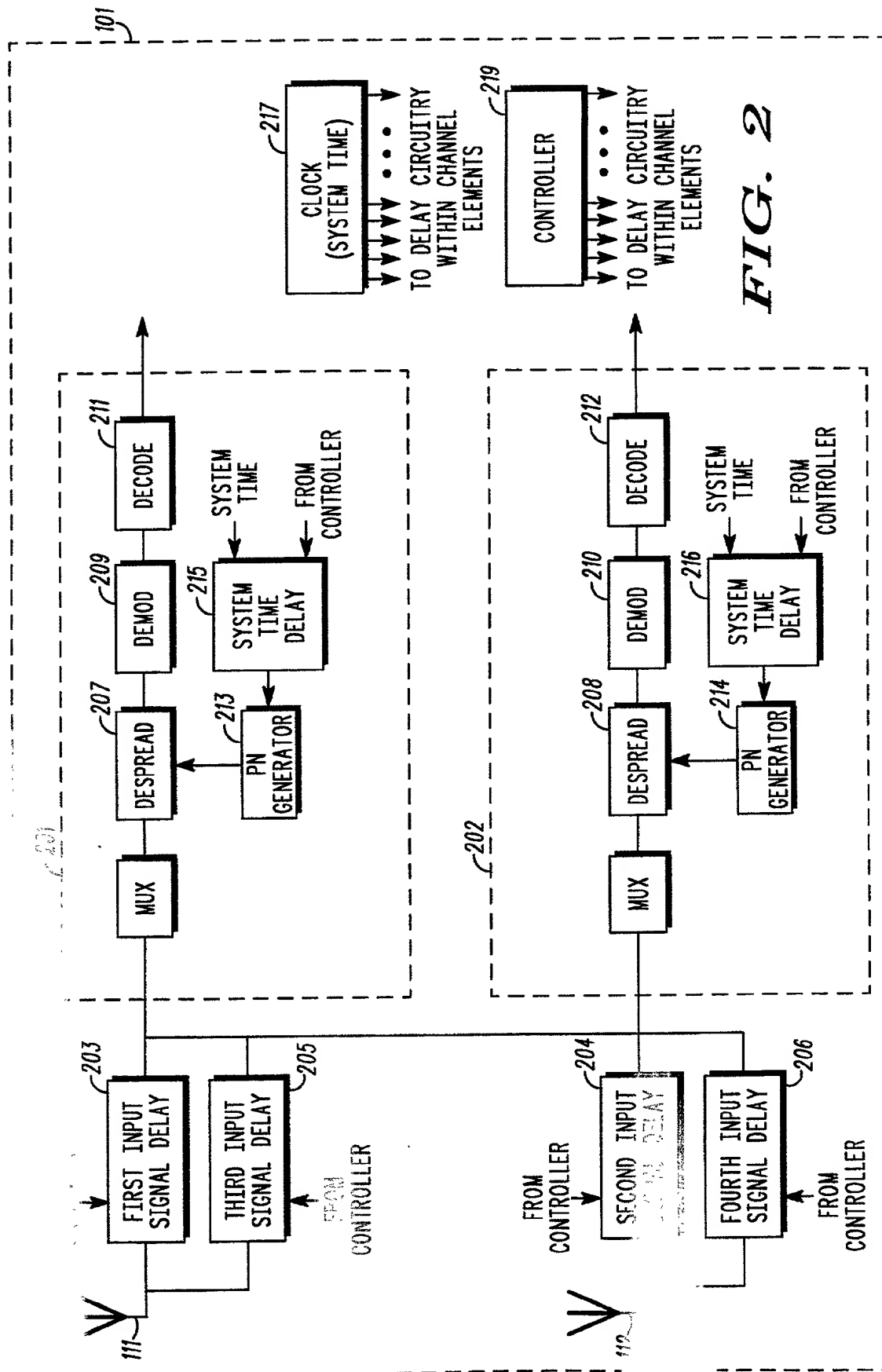


FIG. 3





PATENT
Attorney Docket No. 440490

COMBINED DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION
AND POWER OF ATTORNEY

- ☐ Declaration Submitted with Initial Filing OR
☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name. I believe I am the original, first, and sole inventor (*if only one name is listed below*) or an original, first, and joint inventor (*if plural names are listed below*) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SEPARATION DEVICES AND PROCESSES

the specification of which:

- ☐ is attached hereto.
☐ was filed on _____ as Application No. _____ and was amended on _____ (*if applicable*).
☐ was filed by Express Mail No. _____ as Application No. *not known yet*, and was amended on _____ (*if applicable*).
☒ was filed on January 31, 2000 as PCT International Application No. PCT/US00/02071.

I state that I have reviewed and understand the contents of the specification identified above, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I claim foreign priority benefits under 35 USC 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application(s) designating at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application(s) for patent, utility model, design registration, inventor's or plant breeder's rights certificate(s), or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter and having a filing date before that of the application(s) from which the benefit of priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Claimed		Certified Copy Attached?	
			YES	NO	YES	NO
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



PATENT
Attorney Docket No. 440490

COMBINED DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION
AND POWER OF ATTORNEY

- ☐ Declaration Submitted with Initial Filing OR
☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name. I believe I am the original, first, and sole inventor (*if only one name is listed below*) or an original, first, and joint inventor (*if plural names are listed below*) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SEPARATION DEVICES AND PROCESSES

the specification of which:

- ☐ is attached hereto.
☐ was filed on _____ as Application No. _____ and was amended on _____ (*if applicable*).
☐ was filed by Express Mail No. _____ as Application No. *not known yet*, and was amended on _____ (*if applicable*).
☒ was filed on January 31, 2000 as PCT International Application No. PCT/US00/02071.

I state that I have reviewed and understand the contents of the specification identified above, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I claim foreign priority benefits under 35 USC 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application(s) designating at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application(s) for patent, utility model, design registration, inventor's or plant breeder's rights certificate(s), or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter and having a filing date before that of the application(s) from which the benefit of priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Claimed		Certified Copy Attached?	
			YES	NO	YES	NO
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In re Appin. of FENDYA, ET AL.
Attorney Docket No. 440490

As a named inventor, I hereby appoint Leydig, Voit & Mayer, Ltd. to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Customer Number 23548.

**23548**

PATENT TRADEMARK OFFICE

I further direct that correspondence concerning this application be directed to Leydig, Voit & Mayer, Ltd.: Customer Number 23548.

**23548**

PATENT TRADEMARK OFFICE

I declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Thomas J. Fendya

Inventor's signature _____

Date _____

Country of Citizenship: USA

Residence: Homer, New York

Post Office Address: 137 North Main Street, Homer, NY 13077

Full name of second joint inventor: Mark F. Hurwitz

Inventor's signature _____

Date _____

Country of Citizenship: USA

Residence: Ithaca, New York

Post Office Address: 345 Snyderhill Road, Ithaca, NY 14850

In re Appln. of FENDYA, ET AL.
Attorney Docket No. 440490

As a named inventor, I hereby appoint Leydig, Voit & Mayer, Ltd. to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Customer Number 23548.

**23548**

PATENT TRADEMARK OFFICE

I further direct that correspondence concerning this application be directed to Leydig, Voit & Mayer, Ltd.: Customer Number 23548.

**23548**

PATENT TRADEMARK OFFICE

I declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Thomas J. Fendya

Inventor's signature

Thomas J. Fendya

Date

March 11, 2002

Country of Citizenship: USA

Residence: Homer, New York

Post Office Address: 137 North Main Street, Homer, NY 13077

Full name of second joint inventor: Mark F. Hurwitz

Inventor's signature

Mark F. Hurwitz

Date

March 11, 2002

Country of Citizenship: USA

Residence: Ithaca, New York

Post Office Address: 345 Snyderhill Road, Ithaca, NY 14850

Initial 07/30/01

State or Prov. of Residence:: New York
Country of Residence:: USA
Street:: 137 North Main Street

City:: Homer
State or Province:: New York
Country:: US
Postal or Zip Code:: 13077

Inventor Authority Type:: Inventor
Primary Citizenship Country:: US
Status:: Full Capacity
Given Name:: Mark
Middle Name:: F.
Family Name:: HURWITZ
Name Suffix::

City of Residence:: Ithaca
State or Prov. of Residence:: New York
Country of Residence:: USA
Street:: 345 Snyderhill Road

City:: Ithaca
State or Province:: New York
Country:: US
Postal or Zip Code:: 14850

Inventor Authority Type:: Inventor
Primary Citizenship Country:: US
Status:: Full Capacity
Given Name:: John
Middle Name:: D.
Family Name:: MILLER
Name Suffix::

City of Residence:: Ithaca
State or Prov. of Residence:: New York
Country of Residence:: USA
Street:: 511 Kline Road

City:: Ithaca
State or Province:: New York
Country:: US
Postal or Zip Code:: 114850

Inventor Authority Type:: Inventor
Primary Citizenship Country:: US
Status:: Full Capacity
Given Name:: Stephen
Middle Name:: A.
Family Name:: GEIBEL
Name Suffix::
City of Residence:: Cortland
State or Prov. of Residence:: New York
Country of Residence:: USA
Street:: 31 Prospect Terrace

City:: Cortland
State or Province:: New York
Country:: US
Postal or Zip Code:: 13045

CORRESPONDENCE INFORMATION

Correspondence Customer Number:: 23548
Phone:: (202) 737-6770
Fax:: (202) 737-6776
Electronic Mail:: dcmail@leydig.com

REPRESENTATIVE INFORMATION

Representative Customer Number::	23548	
Representative Designation::	Registration Number::	Representative Name::

DOMESTIC PRIORITY INFORMATION

Application::	Continuity Type::	Parent Application::	Parent Filing Date::

FOREIGN APPLICATION INFORMATION

Country::	Application Number::	Filing Date::
US	60/114,972	01/29/99
WO	PCT/US00/02071	01/31/00

ASSIGNEE INFORMATION

Assignee name:: Pall Corporation
 Street:: 2200 Northern Boulevard

City:: East Hills
State or Province:: New York
Country:: USA
Postal or Zip Code:: 11548-1209

09/890355